

Application No. 09/619,123

Filed: July 19, 2000

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AMENDMENT TO THE CLAIMS

1. (Withdrawn) A method of ultrasound imaging comprising:

 providing a hand-held probe housing having a transducer array, and interface unit connected to the probe housing and a personal computer connected to the interface unit;

 receiving ultrasound signals with the transducer array from a region of interest and generating a continuous time input signal;

 sampling the continuous time input signal and generating discrete time sampled signals;

 delaying the discrete time sampled signals with a beamformer circuit;

 generating an electronic representation of the region of interest with the delayed discrete time sampled signals; and

 forwarding the electronic representation from the interface unit to the personal computer.
2. (Withdrawn) The method of claim 1 wherein the sampling step further comprises generating analog discrete time sampled signals.
3. (Withdrawn) The method of claim 1 wherein the hand-held housing is selected from the group comprising a linear array probe, a curved array probe, and a phased array probe.

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4. (Withdrawn) The method of claim 1 further comprising providing an interface circuit having a digital signal processor.
5. (Withdrawn) The method of claim 1 further comprising providing a cable between the interface unit and personal computer and sending real-time data along the cable.
6. (Withdrawn) The method of claim 1 wherein the delaying step further comprises providing a charge coupled device (CCD) beamformer circuit.
7. (Withdrawn) The method of claim 5 wherein the step of sending real-time data further comprises sending digital data along the cable.
8. (Withdrawn) The method of claim 1 wherein the step of providing a personal computer further comprises providing a portable computer with a liquid crystal display.
9. (Withdrawn) The method of claim 1 wherein the step of providing a personal computer further comprises providing a laptop computer.
10. (Withdrawn) The method of claim 1 wherein the step of providing a personal computer further comprises providing a handheld computer.
11. (Withdrawn) The method of claim 5 further comprising filtering the real-time data with a filter.

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12. (Withdrawn) The method of claim 5 further comprising demodulating the real-time data.
13. (Withdrawn) The method of claim 1 further comprising transmitting beamformer circuit control signals from the interface to the probe housing.
14. (Withdrawn) The method of claim 1 further comprising providing a wireless connection between the interface and a computer.
15. (Withdrawn) The method of claim 1 wherein the providing step further comprises providing a two dimensional transducer array.
16. (Withdrawn) The method of claim 5 further comprising a modem connected to the computer.
17. (Withdrawn) The method of claim 5 wherein the providing step further comprises providing a probe housing, an interface, a computer and a cable having a weight of ten pounds or less.
18. (Withdrawn) The method of claim 1 further comprising providing a computer housing and a cable connecting the interface to the computer housing.
19. (Withdrawn) The method of claim 18 further comprising providing a battery and scan conversion circuitry within the computer.
20. (Withdrawn) The method of claim 1 wherein the generating step further comprises generating a plurality of images of

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the region of interest and selecting one of the images on a display.

21. (Withdrawn) The method of claim 20 further comprising storing the selected image in an electronic memory.
22. (Withdrawn) The method of claim 20 wherein the generating step further comprises generating a real time series of images of the region of interest on a display, and freezing an image on the display, or alternatively, alter the image as a function of depth in the region of interest.
23. (Withdrawn) The method of claim 1 further comprising providing a window operating system on the personal computer.
24. (Withdrawn) The method of claim 1 further comprising providing a display connected to the personal computer and a graphical user interface.
25. (Withdrawn) An ultrasound imaging system comprising:

a hand-held probe housing having a transducer array circuit, the transducer array circuit generating a continuous time input signal;

a beamformer circuit that samples and delays the continuous time input signal and generates discrete time sampled signals;

a summing circuit that generates an electronic representation of the region of interest with the delayed discrete time sampled signals;

an interface unit connected to the probe housing'

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a data processor housing having a memory and a data processor, the data processor generating ultrasound images from the electronic representation of the region of interest;

a cable connecting the interface unit to the data processor housing such that the electronic representation is conducted along the cable to the data processor; and

a display for presenting ultrasound images transferred from the processor.

26. (Withdrawn) The system of claim 25 wherein the hand-held probe housing is selected from the group comprising a linear array probe, a curved array probe, and a phased array probe.
27. (Withdrawn) The system of claim 25 further comprising a second cable connecting the interface circuit and the probe housing.
28. (Withdrawn) The system of claim 25 wherein the beamformer circuit further comprises a charge coupled device (CCD) beamformer circuit.
29. (Withdrawn) The method of claim 25 further comprising an analog to digital converter such that digital data is directed along the cable.
30. (Withdrawn) The system of claim 25 wherein the data processor further comprises a personal computer.

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31. (Withdrawn) The system of claim 25 wherein the data processor further comprises a laptop computer.
32. (Withdrawn) The system of claim 25 wherein the data processor further comprises a handheld computer.
33. (Withdrawn) The system of claim 25 further comprising a filter that filters the electronic representation.
34. (Withdrawn) The system of claim 25 further comprising a demodulator that demodulates the data.
35. (Withdrawn) The system of claim 25 further comprising a beamformer control circuit in the data processor housing that sends beamformer control signals to the probe housing.
36. (Withdrawn) The system of claim 25 the beamformer circuit further comprises a plurality of programmable tapped delay lines.
37. (Withdrawn) The system of claim 25 further comprising a battery providing power to the data processor.
38. (Withdrawn) The system of claim 25 further comprising a scan conversion circuit that converts the electronic representation from polar coordinates to rectangular coordinates.

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39. (Withdrawn) The system of claim 25 further comprising a keyboard and a flat panel display on the data processor housing.

40. (Withdrawn) An ultrasound imaging system comprising:

a hand-held probe housing having a transducer array, the transducer array receiving signals from a region of interest and that generates an input signal;

a beamformer circuit that samples the input signal and that generates discrete time sampled signals, the beamformer circuit delaying the discrete time sampled signals;

a summing circuit that generates an electronic representation of the region of interest with the delayed discrete time sampled signals; and

a cable that connects an interface unit to a personal computer having a memory, a processor, a graphical user interface and a display such that the electronic representation is conducted along the cable to the computer and is processed in the processor to generate ultrasound images, the ultrasound images being transferred to the display.

41. (Withdrawn) The system of claim 40 wherein the hand-held probe housing is selected from the group comprising a linear array probe, a curved array probe, and a phased array probe.

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42. (Withdrawn) The system of claim 40 further comprising a second cable that connects the interface unit and the probe housing.
43. (Withdrawn) The system of claim 40 wherein the beamformer circuit further comprises a charge coupled device (CCD) beamformer circuit.
44. (Withdrawn) The system of claim 40 wherein the personal computer further comprises a scan conversion program.
45. (Withdrawn) The system of claim 40 wherein the computer comprises a laptop computer.
46. (Withdrawn) The system of claim 40 wherein the computer comprises a handheld computer.
47. (Withdrawn) The system of claim 40 further comprising a filter in the probe housing that filters the delayed signals.
48. (Withdrawn) The system of claim 40 further comprising a demodulator that demodulates the delayed signals.
49. (Withdrawn) The system of claim 40 further comprises a beamformer control circuit that transmits signals from the computer to the probe housing.

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50. (Withdrawn) The system of claim 40 wherein the transducer array comprises a plurality of rows, each row comprising a linear array.
51. (Withdrawn) The system of claim 40 wherein the transducer array comprises a plurality of parallel rows such that one of the rows is longer than another of the rows.
52. (Withdrawn) The system of claim 40 further comprising a virtual control panel.
53. (Withdrawn) The system of claim 40 wherein the personal computer further comprises a Windows operating system.
54. (Withdrawn) The system of claim 40 further comprising a disk data storage system such that images can be stored on a disk.
55. (Withdrawn) The system of claim 40 wherein the display comprises a flat panel display.
56. (Withdrawn) The system of claim 40 wherein the display comprises a liquid crystal display.
57. (Withdrawn) The system of claim 40 wherein the interface unit comprises a processor circuit.
58. (Withdrawn) The system of claim 40 wherein the personal computer comprises a doppler processor.

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59. (Withdrawn) The system of claim 40 further comprising a modem for remote transmission of image data.
60. (Withdrawn) The system of claim 40 further comprising a battery that provides power to the computer, the interface and the probe housing.
61. (Withdrawn) The system of claim 25 wherein the display is integral with the data processor.
62. (Withdrawn) The system of claim 25 wherein the display is located at a site remote from the data processor.
63. (Withdrawn) The system of claim 25 further comprising generating a plurality of images of the region of interest for display and selecting one of the images for display on the display.
64. (Withdrawn) The system of claims 63 further comprising storing the selected image in a memory.
65. (Withdrawn) The system of claim 63 wherein the plurality of images further comprises images of moving objects processed using a Doppler processor.
66. (Withdrawn) The system of Claim 25 wherein the electronic representation of the region of interest further comprises one of digital signal data and analog signal data.

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67. (Withdrawn) The system of claim 25 further comprising a video compression device in communication with the data processor.
68. (Withdrawn) The system of claim 40 wherein the display is integral with the data processor.
69. (Withdrawn) The system of claim 40 wherein the display is located at a site remote from the data processor.
70. (Withdrawn) The system of claim 40 further comprising generating a plurality of images of the region of interest for display and selecting one of the images for display on the display.
71. (Withdrawn) The system of claim 70 further comprising storing the selected images in a memory.
72. (Withdrawn) The system of claim 70 wherein the plurality of images further comprises images of moving objects processed using a Doppler processor.
73. (Withdrawn) The system of Claim 40 wherein the electronic representation of the region of interest further comprises one of digital signal data and analog signal data.
74. (Withdrawn) The system of claim 40 further comprising a video compression device in communication with the data processor.

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75. (Amended) An ultrasonic diagnostic imaging system comprising:

an ultrasonic array probe connected to an imaging system having a computer platform with a central processing unit (CPU) that receives beamformed image data from a beamforming circuit having at least 10 channels, the computer platform comprising:

~~a personal computer platform having a central processing unit (CPU) and comprising:~~

signal processing software for performing at least one of scan conversion and Doppler processing of processed signals from a region of interest; and

display processing software for performing display processing of said processed signals; and

a display coupled to said personal computer platform to receive processed signals for display of an ultrasonic image, the imaging system having a weight of ten pounds or less.

76. (Amended) The ultrasonic diagnostic imaging system of claim 75 wherein said ~~personal~~ computer platform further comprises a memory.

77. (Previously Presented) The ultrasonic diagnostic imaging system of claim 75 wherein said signal processing software and said display processing software are executed by said CPU.

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78. (Amended) An ultrasonic diagnostic imaging system comprising:

an ultrasonic array probe connected to an imaging system that includes a beamforming device, having at least 32 channels and a computer platform having a central processing unit (CPU) that receives beamformed image data from the beamforming device, the computer platform comprising:

~~a personal computer platform having a central processing unit (CPU) and comprising:~~

a buffer memory to store shared digital data from a region of interest;

signal processing software for processing said shared digital data from the region of interest to generate digital images of the region of interest; and

a display coupled to said ~~signal processing software computer platform~~ for displaying said digital images of the region of interest, the imaging system having a weight of 10 pounds or less.

79. (Amended) The ultrasonic diagnostic imaging system of claim 78 wherein said ~~personal~~ computer platform further comprises a scan conversion circuit.
80. (Amended) The ultrasonic diagnostic imaging system of claim 78 wherein said ~~personal~~ computer platform further comprises a beamformer control circuit.

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81. (Previously Presented) The ultrasonic diagnostic system of claim 78 wherein the beamforming device comprises a charge domain processing device.
82. (Previously Presented) The ultrasonic diagnostic system of claim 78 wherein the display comprises a flat panel display attached to the computer.
83. (Previously Presented) The system of claim 75 further comprising a beamformer control circuit to control a plurality of differential delays used by a beamformer in response to signals received by the probe from a region of interest.
84. (Amended) The system of claim 75 wherein the probe has at least 64 transducerseystem has a weight of 10 pounds or less.
85. (Previously Presented) The system of claim 75 wherein the system is battery operated.
86. (Previously Presented) The system of claim 75 further comprising a wireless connection.
87. (New) An ultrasonic diagnostic imaging system comprising:

an ultrasonic array probe connected to an imaging system including a beamforming device having at least 64 channels and a computer platform with a central processing unit (CPU) that receives beamformed image data from the beamforming device, the computer platform comprising:

a buffer memory to store image data of a region of interest;

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signal processing software for processing said image data from the region of interest to generate digital images of the region of interest; and

a display coupled to said computer platform for displaying said digital images of the region of interest, the imaging system having a weight of ten pounds or less.

88. (New) The ultrasonic diagnostic imaging system of claim 87 wherein said computer platform further comprises a scan conversion circuit.
89. (New) The ultrasonic diagnostic imaging system of claim 87 wherein said computer platform further comprises a beamformer control circuit and a battery that provides power to the imaging system.
90. (New) The ultrasonic diagnostic imaging system of claim 87 wherein the beamforming device comprises a charge domain processing device.
91. (New) The ultrasonic diagnostic system of claim 87 wherein the display comprises a flat panel display attached to the computer.
92. (New) The system of claim 87 further comprising a beamformer control circuit to control a plurality of differential delays used by a beamforming device in response to signals received by the probe from a region of interest.

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93. (New) The system of claim 87 wherein the probe has at least 64 transducer elements.

94. (New) The system of claim 87 wherein the probe has at least 128 transducer elements.

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